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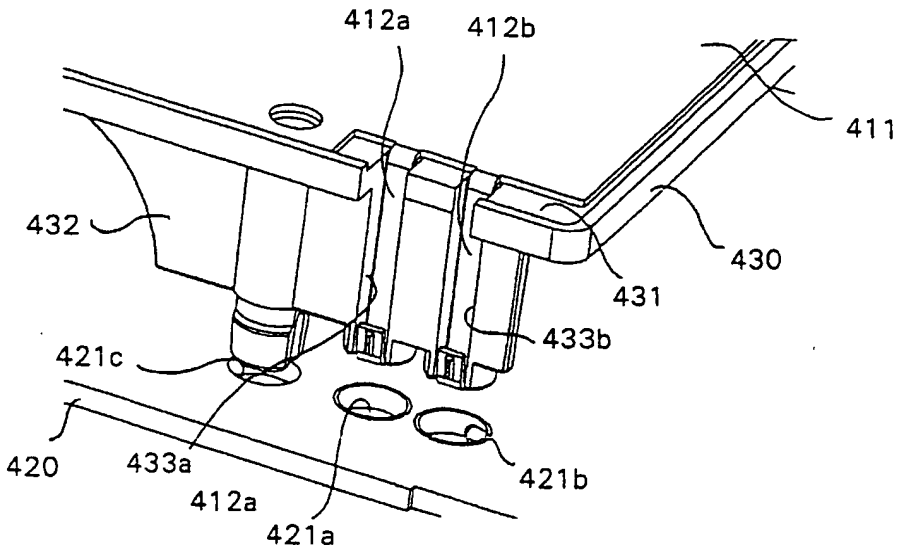

(57) Abstract: An RF connector for use in a portable radio communication device connects a first object (410) and a second object (420). The connector has an electrically conductive body (412a, b) having a longitudinal axis and a first end portion and a second end portion (413a, b). The electrically conductive body is homogenous and the connector also comprises a reception portion (421a, b) for receiving the second end portion of the electrically conductive body and limiting the radial movement of the second end portion of the body. This provides for an RF connector, which is easy and inexpensive to manufacture and assemble and the RF connector has a fixed, well-defined contact point.

WO 02/27859 A1

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RF CONNECTOR

FIELD OF INVENTION

The present invention relates generally to electrical connectors and more particularly to an RF connector for use in a portable radio communication device. It also relates to a portable radio communication device, such as a mobile phone, comprising such an RF connector.

BACKGROUND

It is previously known so-called contact pins in the technical field of mobile phones. Such contact pins are used as radio frequency contact means between for example a built in or internal radiating element and a printed circuit board (PCB). An example of such pins is sold under the trademark PoGo, so-called PoGo-pins. Because there is radio frequency applications involved, it is of vital importance that the contact point is well defined, as otherwise the RF characteristics will vary for the radiating element in an unwanted way.

Mobile phones are also subject to cost reduction demands as well as increasing adaptation for large scale manufacturing. For that reason parts included in a mobile phone are preferably designed to ensure low manufacturing and assembling costs.

The PCT application with publication no. WO 94/23475 discloses a spring biased tapered contact element for an electrical connector or an integrated circuit. The contact element has a base portion, a spring portion

having at least partially helical spring elements, and a tapered contact portion which mates in a biased manner with the conductive rim of a hole. Although this contact element is fixed against radial movement by its tapered contact portion resting against the rim of the hole, it is not suitable for RF applications. One of the reasons therefor is that the spring portion of the contact element causes unwanted losses and other effects to the RF signals transferred by the contact element. Examples of such effects are that it is difficult to control the contact pressure exerted on the contacted element. Also, the contact point is not well-defined and the contact element is prone to deformation. The impedance of the contact element varies in an uncontrolled way as the length of the spring portion varies with the contact pressure. Also a relatively high inductance is added in the disclosed device. Finally, a uniform rim pressure is not ensured, causing an unreliable interface between the contact element and the rim of the hole.

SUMMARY OF THE INVENTION

An object of the present invention is to provide an RF connector for use in a portable radio communication device wherein the contact point between the connector and a contacted object is well defined and adapted for good RF signal transfer.

Another object of the present invention is to provide an RF connector which is easy and inexpensive to manufacture and assemble.

The invention is based on the realisation that a well-defined contact point is achieved when the connector or the end portion thereof is fixed against radial movement.

According to the present invention there is provided an RF connector as defined in appended claim 1.

With the inventive RF connector the above mentioned drawbacks of prior art are eliminated or at least mitigated. The connector according to the present invention as defined by the appended claims provides a well defined path for RF signals passing between two objects, such as a radiating element and a printed circuit board of a mobile phone. The homogenous body further adds to this well-defined signal path as it has no singular portions negatively affecting an RF signal passing therethrough.

By means of the reception portion radially exerting a force on the conductive body, the contact pressure is independent of longitudinal forces. This provides for a more precise connection between the connected objects.

The dependent claims define further preferred embodiments of the inventive RF connector.

BRIEF DESCRIPTION OF DRAWINGS

The invention is now described, by way of example, with reference to the accompanying drawings, in which:

FIGS. 1a and 1b are sectional views of a first embodiment of an RF connector according to the invention be-

fore and after contact has been made between two objects, respectively;

FIGS. 2a and 2b are sectional views of two variants of a second embodiment of an RF connector according to the invention after contact has been made between two objects;

FIGS. 3a is a perspective view of a third embodiment of an RF connector according to the invention in connected position;

FIG. 3b is a plan view of the connector shown in FIG. 3a;

FIG. 3c is a sectional view of the connector shown in FIG. 3b taken along the lines 3c-3c;

FIGS. 4a and 4b are perspective views of a fourth embodiment of an RF connector according to the invention before and after contact has been made, respectively;

FIG. 4c is a sectional view of the connector shown in FIG. 4b taken along the lines 4c-4c;

FIGS. 5a and 5b are perspective views of a fifth embodiment of an RF connector according to the invention before and after contact has been made, respectively;

FIG. 5c is a sectional view of the connector shown in FIG. 5b taken along the lines 5c-5c;

FIGS. 6a and 6b show a mobile phone housing and a radiating element, respectively, used with a sixth embodiment of an RF connector according to the present invention;

FIG. 6c is a view of the radiating element shown in fig. 6b mounted in the housing shown in fig. 6a;

fig. 6d is a view similar to that of fig. 6c but also showing a PCB mounted in the housing;

figs. 7a and 7b show a seventh embodiment of an RF connector according to the present invention, which is similar to that shown in figs. 6c and 6d;

fig. 8a is a view of the different parts used with an eighth embodiment of an RF connector according to the present invention before assembly; and

figs. 8b and 8c show different stages of assembly of the parts shown in fig. 8a.

DETAILED DESCRIPTION OF THE INVENTION

In the following, a detailed description of various embodiments of an RF connector according to the invention will be given. In the description, for purposes of explanation and not limitation, specific details are set forth, such as particular hardware, applications, techniques etc. in order to provide a thorough understanding of the present invention. However, it will be apparent to one skilled in the art that the present invention may be utilised in other embodiments that depart from these specific details. In other instances, detailed descriptions of well-known methods, apparatuses, and circuits are omitted so as not to obscure the description of the present invention with unnecessary details.

In this disclosure it is to be understood that the radiating element is operable to transmit and/or

receive RF signals. Even if a term is used herein that suggests one specific signal direction it is to be appreciated that such a situation can cover that signal direction and/or its reverse, unless specifically stated otherwise.

Also, in some of the figures, only part of the elements used with the present invention is shown. The omitted portions are to be understood as being obvious for the man skilled in the art and showing those portions would not contribute to the understanding of the present invention.

A first embodiment of an RF connector according to the invention will now be described with reference to fig. 1. A connector, generally designated 10, comprises an elongated pin shaped contact element 101 made of an electrically conductive material with circular cross-section. The lower end of the contact element is attached to e.g. a printed circuit board 110 in some suitable way, such as by soldering or by means of some of the other embodiments disclosed herein, such as the one described with reference to FIGS. 3a-c. The upper free end 102 of the connector is rounded and functions as a contact portion adapted to co-operate with a concave recess 121 provided in an element 120 to be contacted. In the present example, the element 120 is a built in radiating element of an antenna of a portable radio communication device, such as a mobile phone. The radiating element 120 is generally planar but is provided with the recess 121 in the contact area. The circular recess can be provided by means of e.g. a punch process. Thus, the inner surface of the recess

121 is provided with a surface of conductive material so as to enable electrical connection to the contact portion 102 of the contact element 101.

During assembly, the radiating element 120 is simply pressed against the contact element with the recess 121 guiding the contact end portion 102 of the contact element 101. The end portion 102 is then guided to a fixed radial position due to the concave nature of the recess 121 so that the tip of the contact portion rests in the bottom centre area of the recess. The radiating element is then fixed in place by means of e.g. a snap-in function, i.e., by means of resilient hooks gripping around the edges of the radiating element. Also, the radiating element can be mounted on some kind of frame supporting the radiating element.

Also, the contact element 101 is preferably resiliently attached to the PCB 110, e.g., by means of a resilient tongue (not shown). This creates a spring force pressing the contact element 101 towards the radiating element 120, ensuring that the contact portion 102 rests securely in the recess 121.

A second embodiment of a connector according to the invention will now be described with reference to figs. 2a and 2b. In this embodiment, the connector, generally designated 20, comprises an essentially S-shaped contact element 201 made of for example sheet metal. The contact element is provided with two essentially identical end portions 202 functioning as contact portions for a respective contact area on a first and a second object 210, 220 to be interconnected. The

first object 210 could be e.g. a radiating element and the second object 220 could be a PCB.

Contact areas on the objects 210, 220 are provided as recesses 211, 221 functioning to locate the end portions 202 in fixed positions. During assembly, the contact element 201 is positioned so as to be pressed between the two elements 210, 220. The S-shape gives the contact element 201 resilient characteristics, enabling compression thereof during assembly. Thus, the contact element is held in place by an inherent spring force.

In fig. 2a, the contact areas have been shown as recesses. A variant thereof is shown in fig. 2b, wherein the recesses have been replaced by a respective through hole 211', 221' located in the elements 210', 220'. The holes 211', 221' have a conductive rim, which in assembled state are in contact with the contact portions 202 of the contact element 201. This conductive rim can be provided as plated through holes, as is conventional with PCBs.

In yet an alternative variant not shown in the figures, one of the end portions of the contact element 201 is fixedly attached to one of the elements to be interconnected by means of soldering or riveting.

A third embodiment of a connector according to the invention will now be described with reference to figs. 3a-c, wherein an antenna element (not shown) is attached to a PCB 320 by means of a connector. The connector, generally designated 30, comprises an essentially pin shaped contact element 301 with circular

cross-section interconnecting the antenna element and the PCB. The ends of the contact element, one 302 of which is shown in the figures, are held in place by means of a respective identical contact clip 321, one of which (not shown) is attached to the antenna element and the other is attached to the PCB 320 by means of e.g. soldering or riveting.

Each contact clip 321 is provided with four resilient and uniformly spaced tongues 322, see fig. 3b. A sectional view taken along the lines 3c-3c in fig. 3b is shown in fig. 3c. With the contact element 301 in position, the tongues 322 are biased outwardly, thereby exerting a inwardly directed radial pressure on the contact element 301. This pressure keeps the contact element 301 in place and prevents unwanted radial movement thereof.

The contact clip 321 is preferably made of one piece of sheet metal having wings, which are subsequently bent to the tongues 322 with final shape as shown in fig. 3c, for example.

With this connector arrangement, four well-defined contact points are obtained at each end of the contact element 301, thus providing a satisfying RF connection between an antenna element and electronic circuitry provided on a PCB.

A fourth embodiment of an RF connector according to the invention will now be described with reference to figs. 4a-c. In this embodiment, a built in essentially planar radiating antenna element 410 of a mobile phone

(not shown) is to be connected to a PCB, generally designated 420.

In this embodiment and the embodiments described below, the radiating element is described as a planar conductive element of for example sheet metal and having an essentially square or rectangular shape. However, it is to be realised that in practice the radiating element can take many different shapes and the rectangular shape shown in the figures is just a general outline of the shape of the radiating element. Also, although the radiating element preferably is made of a sheet metal, also other solutions are viable, such as a plastic support having a conductive flex film attached thereto and functioning a antenna pattern.

The radiating element 410 has a planar main portion 411 and is supported by a frame 430 made of some non-conductive material, such as plastics. The frame has a planar upper surface 431 essentially corresponding to the size of the main portion 411 of the radiating element. The frame 430 is provided with a depending portion 432 having two grooves or recesses 433a, 433b formed therein that run essentially perpendicularly to the upper surface 431 of the frame. The grooves 433a, 433b are connected to the upper surface 431 by means of the upper surface 431 of the frame having cut out edge portions aligned with the grooves 433a, 433b, see fig. 4a. These cut out portions are shaped so as to receive a respective contact portion or leg 412a, 412b depending from the main portion 411 of the radiating element 410 at right angle. The lower end portions

413a, 413b of the legs are bent essentially 180 degrees so that the legs are given a J-shape when viewed sideways, see also fig. 4c.

The PCB 420 is provided with three through holes, two of which 421a, 421b are designed to receive lower part of the depending portion 432 and the end portions 413a, 413b of the legs 412a, 412b. As is best seen in fig. 4c, which is a sectional view of the first leg 412a and the PCB in connected position of the radiating element 410, the end 413a is supported on the back side thereof by the depending part 432 of the frame 430, i.e., the part 432 is shaped so as to rest in the holes 421a, 421b.

The third hole 421c is provided for mounting purposes.

The holes 421a, 421b for the legs are provided with a conductive rim, e.g., by means of a through plating process. When the frame 430 with the radiating element 410 mounted thereon is attached to the PCB 420, the depending portion 432 and the legs 412a, 412b are lowered into the holes 421a, 421b until the end portions 413a, 413b of the legs are almost fully positioned in the holes, see figs. 4b and 4c. In that position, the outer portions of the J-shaped end portions are pressed against the conductive rim of the holes 421a, 421b, thus establishing a well-defined contact point between the radiating element 410 and electronic circuitry (not shown) provided on the PCB 420. The rims of the holes 421a, 421b fix the respective leg 412a, 412b against radial movement.

A fifth embodiment of an RF connector according to the invention will now be described with reference to figs. 5a-c. This fifth embodiment is similar to the fourth embodiment described with reference to figs. 4a-c and thus fig. 5a shows a radiating antenna element 510 having a planar main portion 511, a PCB 520 and a frame 530 for supporting the radiating element. However, in this embodiment the frame is provided with four depending mounting portions, two of which 531a-b are shown in fig. 5a. The mounting portions are designed for a snap-in mounting of the frame to the PCB and with the radiating element essentially parallel thereto. To that end, the PCB 520 is provided with four holes, two of which 521a-b are shown in fig. 5a, for reception of the end portions of the mounting portions of the frame 530.

One of the holes 521b is through plated, i.e., the rim thereof is provided with a conductive surface. The corresponding mounting portion 531b is provided with a groove or recess 532 similar to the grooves 433a, 433b shown in fig. 4a and with the same function, i.e., to receive a leg shaped contact portion 512 of the radiating element 510. However, in this fifth embodiment, the end portion 513 of the leg 512 is not bent 180 degrees but has only a convex portion facing the rim of the hole 521b when mounted therein. The function remains essentially the same, i.e., when mounted in the hole 521b, see figs. 5b and 5c, the end portion 513 of the leg 512 is supported by the groove 532 of the mounting portion 531b in such a way that the convex surface is pressed against the rim of the hole, thus establishing electrical contact therewith.

A sixth embodiment of an RF connector according to the invention will now be described with reference to figs. 6a-d. In fig. 6a, part of a housing for a mobile phone is shown generally designated 630. The housing is generally box shaped with an essentially planar bottom portion 631 and walls 632 surrounding the bottom portion. The walls are provided with a ledge shaped portion at the upper end thereof, acting as a support for a PCB mounted in the housing, see below.

Two circular pedestal shaped supports 633a, 633b protrude from the bottom portion 631 and essentially perpendicularly thereto. The supports 633a, 633b have a respective groove 634a, 634b running from the bottom portion 631 and to the top end of the supports, wherein the top end portions have a smaller diameter than the rest of the supports in order to form a ledge for a PCB, see fig. 6d.

There are also two identical projective parts or knobs 635 provided on the bottom portion 631 of the housing. They are provided with tapering upper end portions and are arranged to locate a radiating element 610, which will now be described with reference to fig. 6b.

The radiating element comprises a generally planar, rectangular main portion 611 with a size that fits into the housing 630 shown in fig. 6a. The radiating element is made of some suitable conductive material and is provided with an antenna pattern (not shown). At one end thereof, the main portion 611 is provided with two leg shaped portions 612a, 612b extending essentially perpendicularly to the plane of the main

portion. These legs have a function equivalent to that of the legs 412a, 412b of the fourth embodiment and described with reference to figs. 4a and 4b, as will be further described below. Thus, the end portions 613a, 613b of the legs are bent so as to form a "J" when viewed sideways.

The main portion 611 of the radiating element is also provided with two essentially circular holes 614 positioned so as to cooperate with the projective parts 635 of the housing 630 and with a slightly smaller diameter that the projective parts. However, to the circular shape are added four slits extending from the periphery of the circular portion of the holes, the function of which is to provide a self-locking arrangement during assembly, as will be described with reference to fig. 6c.

In fig. 6c is shown how the radiating element 610 fits into the housing 630. When the radiating element 610 is pressed onto the projective parts 635, the rim of the holes 614 in the radiating element slightly deflects due to the fact that the diameter of the holes is slightly smaller than that of the parts 635. The deflection is made possible by the slits extending from the rim of the holes. Thus, in the position shown in fig. 6c, the radiating element 610 is locked in position by the rims of the holes 614 engaging the projective parts 635.

In fig. 6c is also shown how the legs 612a, 612b run in the grooves 634a, 634b provided in the supports 633a, 633b and thus are supported thereby.

In fig. 6d, a printed circuit board (PCB) 620 is shown mounted to the housing 630 and resting on the ledge shaped portions of the walls 632 thereof as well as the ledge created by the top end portions of the supports 633a, 633b. The PCB is provided with two holes 621a, 621b sized and positioned to cooperate with the upper end portions of the supports 633a, 633b. At least part of the rims of the holes 621a, 621b is plated with a suitable conductive material acting as contact points for electronic circuitry (not shown) arranged on the PCB 620. In the mounted position shown in fig. 6d, the end portions 613b are supported by the supports 633a, 633b and pressed against the conductive rims of the holes 621a, 621b of the PCB 620, thereby providing a reliable RF connection between the radiating element 610 and the electronic circuitry provided on the PCB 620.

The sixth embodiment described with reference to figs. 6a-6b provides for an easy assembly as no extra parts are needed, i.e., no extra frame or support is needed for the radiating element as the phone housing itself provides the necessary support both for the radiating element and for the PCB.

A seventh embodiment of an RF connector according to the invention will now be described with reference to figs. 7a and 7b. This embodiment is very similar to the sixth embodiment described above and comprises a phone housing 730 similar to the housing 630 but with no pedestal shaped supports extending from the bottom portion of the housing. Instead there are provided self-supporting legs 712a, 712b extending essentially

perpendicularly to an essentially planar main portion 711 of a radiating element 710. However, the radiating element 710 is mounted to the housing 730 as in the sixth embodiment and is thus provided with holes 714 cooperating with projective parts 735 of the housing for a self-locking mounting of the radiating element.

The PCB 720 is provided with two holes 721a, 721b, sized and positioned to cooperate with the bent upper end portions 713a, 713b of the legs 712a, 712b, as is seen in fig. 7b. The rims of the holes 721a, 721b are provided with a conductive material so as to function as contact points between the radiating element 710 and the PCB 720.

An eighth embodiment will now be described with reference to fig. 8a-c. In fig. 8a are shown a radiating element 810, a PCB 820 and the bottom portion of a radio communication equipment housing 830. The radiating element comprises a rectangular generally planar main portion 811 provided with a conductive antenna pattern (not shown). Two legs 812a, 812b extend from one edge of the main portion 811 and essentially perpendicularly thereto. The legs have a circular cross-section comprised of a sheet material shaped to essentially a cylinder with a slightly smaller diameter at the upper end 813a, 813b thereof compared to the diameter close to the edge of the main portion 811. There is a small longitudinal slit 814a, 814b in the legs creating a gap in the outer surface and providing a certain degree of flexibility to the diameter of the legs.

The housing 830 comprises an essentially planar portion 831 with two essentially circular protruding portions 833a, 833b provided with a respective groove 834a, 834b. The grooves are arranged to support the lower portions of the legs 812a, 812b of the radiating element 810. There are also provided two projective parts, one of which 835 is shown in the figures and functioning as the projective parts described with reference to fig. 6a-d and 7a-b.

Finally, the PCB 820 is provided with two holes 821a, 821b having rims at least partly covered by a conductive material connected to electronic circuitry mounted to the PCB. The holes are sized and positioned to receive the upper end portions 813a 813b of the legs 812a, 812b of the radiating element.

In fig. 8b, the radiating element 810 is shown mounted to the housing 830. The lower portions of the circular legs 812a, 812b rest on the supports 833a, 833b, preventing the legs from tilting. The projective portions 835 fix the general position of the radiating element by means of holes formed therein.

In fig. 8c, the PCB has been mounted to the housing 830, e.g. in a manner shown in figs. 6d and 7b. The upper end portions 813a 813b of the legs 812a, 812b are in that position received in a respective hole 821a, 821b in the PCB. Because the legs are slightly tapered, i.e., they are widening from the top and down, the outer surfaces of the legs press against the rim of the holes so as to establish a well-defined contact areas between the legs and the rims of the

holes. Also, due to the slits 814a, 814b in the legs, they are slightly flexible, i.e., the diameter thereof can vary to a certain extent, providing for an even better fit between the legs and the holes.

Preferred embodiments of a connector according to the invention have been described. The person skilled in the art realises that these could be varied within the scope of the appended claims. Thus, the shapes of the different parts shown in the figures can of course be adapted to different needs.

In the description of the third embodiment, shown in figs. 3a-3c, the contact pin has been described as attached to two identical spring clips, one at each end of the contact pin. Obviously one of the ends thereof can also be attached in another, conventional way, such as by welding, riveting etc.

Also, the receiving portion 330 described with reference to FIGS. 3a-c comprises four resilient tongues. It is to be understood that a different number of tongues can be provided, such as one, two, or three tongues.

In the embodiments six to eight described with reference to figs. 6a-d, 7a,b, and 8a-c, there is no separate frame for the radiating element. Instead, the phone housing itself supports the radiating element. However, it is realised that that the leg arrangements shown in these figures also are applicable to embodiments having a separate frame being mounted in the housing.

In most of the above described embodiments, there have been two leg portions, one functioning as a grounding portion and the other functioning as a feeding portion of the radiating element. It is realised that the inventive idea is also applicable to embodiments wherein only one leg, as shown in figs. 5a-c, or more than two legs are required.

No antenna patterns have been shown in the figures but the inventive idea is applicable to many kinds of antennas, such as a conventional or modified PIFA, micro-strip, patch, or meander antenna.

The holes in the PCB for receiving the legs of the radiating element have been described as circular. They can of course take another suitable shape, such as square or rectangular.

CLAIMS

1. An RF connector for use in a portable radio communication device, said connector being adapted to provide electrical connection between a first object (110; 210; 210'; 410; 510; 610; 710; 810) and a second object (120; 220; 220'; 320; 420; 520; 620; 720; 820) and comprising:

- an electrically conductive body (101; 201; 301; 412a,b; 512; 612a,b; 712a,b; 812a,b), said body having a longitudinal axis, a first end portion attachable to said first object, and a second end portion (102; 202; 302; 413a,b; 513; 613a,b; 713a,b; 813a,b), and

- a reception portion (121; 221; 221'; 321; 421a,b; 521b; 621a,b; 721a,b; 821a,b) provided on or adapted to be provided on said second object,

characterised in that

- said electrically conductive body is homogenous;

- said reception portion (121;221;221';321; 421a,b;521b;621a,b;721a,b;821a,b) is adapted for receiving said second end portion, wherein said reception portion limits radial movement of said second end portion (102; 202; 302; 413a,413b; 513; 613a,b; 713a,b; 813a,b); and

- said first or second object (110; 210; 210'; 410; 510; 610; 710; 810) is a radiating antenna element.

2. The RF connector according to claim 1, wherein said reception portion (121;221) comprises a recess integral with said second object (120;220).

3. The RF connector according to claim 2, wherein said recess (121;221) is essentially circular.

4. The RF connector according to claim 1, wherein said electrically conductive body (101;301;812a,b) has an essentially circular cross-section.

5. The RF connector according to claim 4, wherein said electrically conductive body (812a,b) comprises a sheet material shaped to essentially a cylinder.

6. The RF connector according to claim 5, wherein said second end portion (813a,b) of said electrically conductive body (812a,b) has a smaller diameter than said first end portion thereof.

7. The RF connector according to any of claims 1-3, wherein said electrically conductive body (201) with said first end portion and said second end portion (202) have an essentially S-shape.

8. The RF connector according to any of claims 1, 4, 5 or 6, wherein said reception portion (221'; 421a,b; 521b; 621a,b; 721a,b; 821a,b) comprises a through hole in said second object (220'; 420; 520; 620; 720; 820).

9. The RF connector according to claim 8, wherein said through hole (221'; 421a,b; 521b; 621a,b; 721a,b; 821a,b) comprises a rim that is at least partly covered by conductive material.

10. The RF connector according to claim 8 or 9, wherein said through hole (221'; 421a,b; 521b; 621a,b; 721a,b; 821a,b) is a plated through hole.

11. The RF connector according to claim 1, wherein said reception portion comprises a spring clip (321) connectable to said second object (320).

12. The RF connector according to claim 11, wherein said spring clip (321) comprises resilient tongues (322), preferably three or four resilient tongues, said tongues acting to limit the radial movement of said second end portion (302) of said electrically conductive body (301).

13. The RF connector according to any of claims 1-12, wherein said first object (110; 210; 210'; 410; 510; 610; 710; 810) is a radiating antenna element and said second object (120; 220; 220'; 320; 420; 520; 620; 720; 820) is a printed circuit board.

14. The RF connector according to claim 13 when dependent on any of claims 1,4-6, and 8-10, wherein said electrically conductive body (412a,b; 512; 612a,b; 712a,b; 812a,b) is unitary with said first object and wherein said axis of the conductive body is essentially perpendicular to an essentially planar portion (411; 511; 611; 711; 811) of said radiating antenna element.

15. The RF connector according to claim 14 when claim 13 is dependent on any of claims 1 and 8-10, wherein said radiating antenna element (410; 510) is supported by a frame (430; 530).

16. The RF connector according to claim 15, wherein said frame (430; 530) comprises a portion (432; 531b) supporting said conductive body (412a,b; 512).

17. The RF connector according to claim 16, wherein said portion (432; 531b) supporting said conductive body (412a,b; 512) comprises at least one groove (433a,b; 532) adapted to receive said conductive body (412a,b; 512).

18. The RF connector according to any of claims 8-10 or 13-17, wherein said second end portion (413a,b; 613a,b; 713a,b) of said electrically conductive body (412a,b; 612a,b; 712a,b) is bent essentially 180 degrees, thereby giving said electrically conductive body essentially a J shape.

19. The RF connector according to any of claims 13-17, wherein said second end portion (513) of said electrically conductive body (512) has a convex surface arranged to abut said reception portion (521b).

20. The RF connector according to claim 14 when claim 13 is dependent on any of claims 1,4-6, and 8-10, wherein said conductive body (612a,b; 812a,b) is supported by a support portion (633a,b; 833a,b) integral with a housing (620; 820) of a device in which said first object (610; 810) and second object (630; 830) are mounted.

21. The RF connector according to claim 20, wherein said support portion (633a,b) is adapted to extend into said reception portion (621a,b).

22. A portable radio communication device comprising a radiating antenna element (110; 210; 210'; 410; 510; 610; 710; 810) and a printed circuit board (120; 220; 220'; 320; 420; 520; 620; 720; 820), characterised in that said radiating antenna element and said printed circuit board are interconnected by means of an RF connector according to any of the preceding claims.

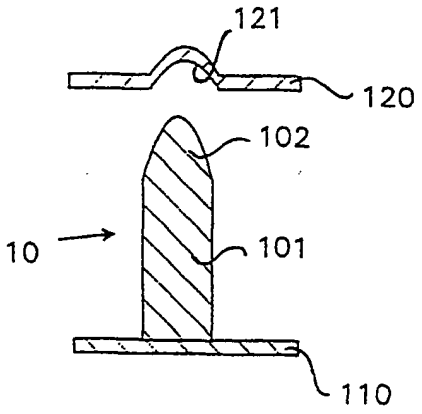


Fig. 1a

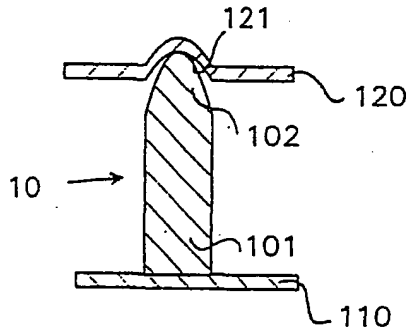


Fig. 1b

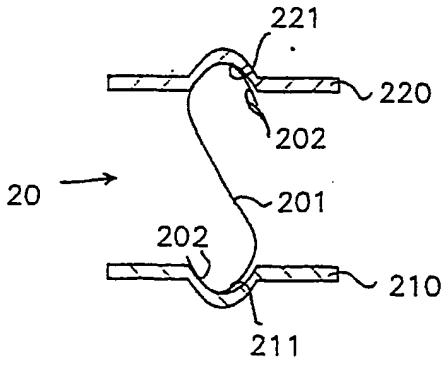


Fig. 2a

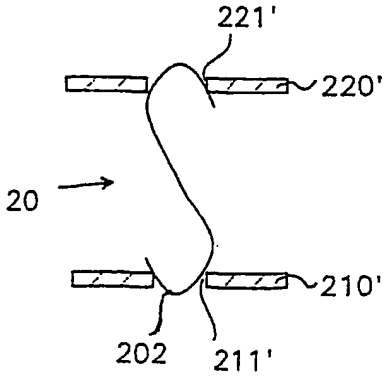


Fig. 2b

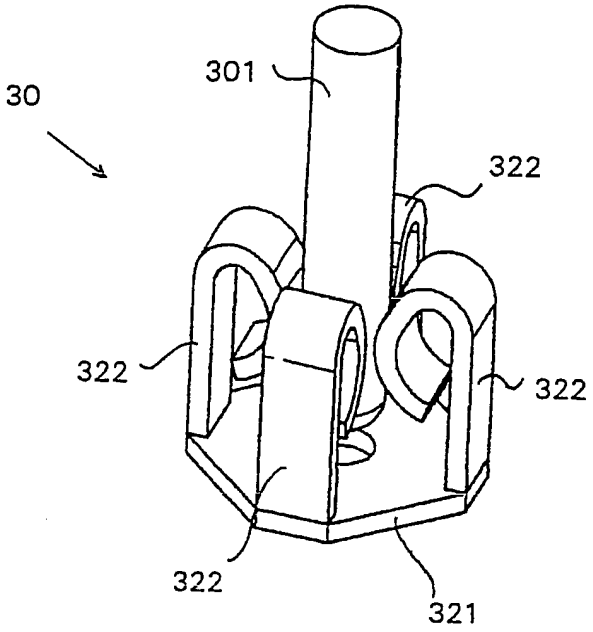


Fig. 3a

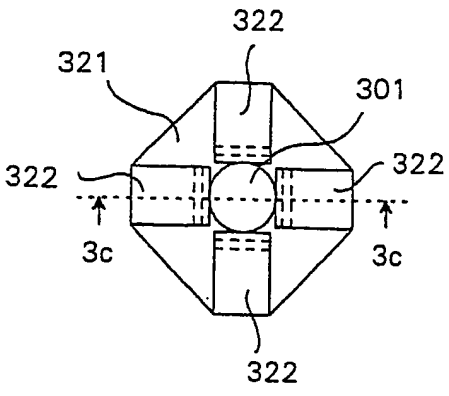


Fig. 3b

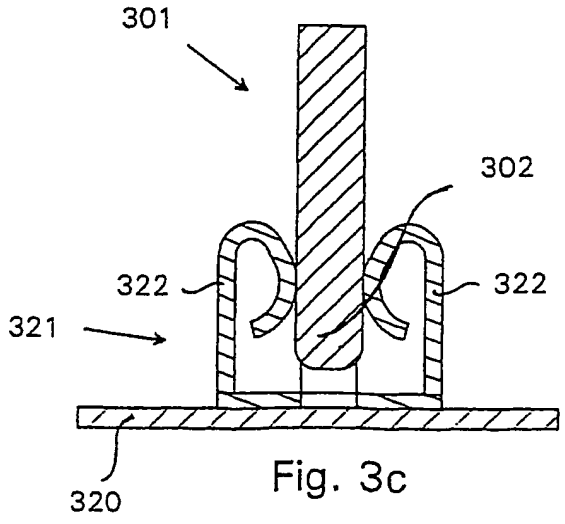


Fig. 3c

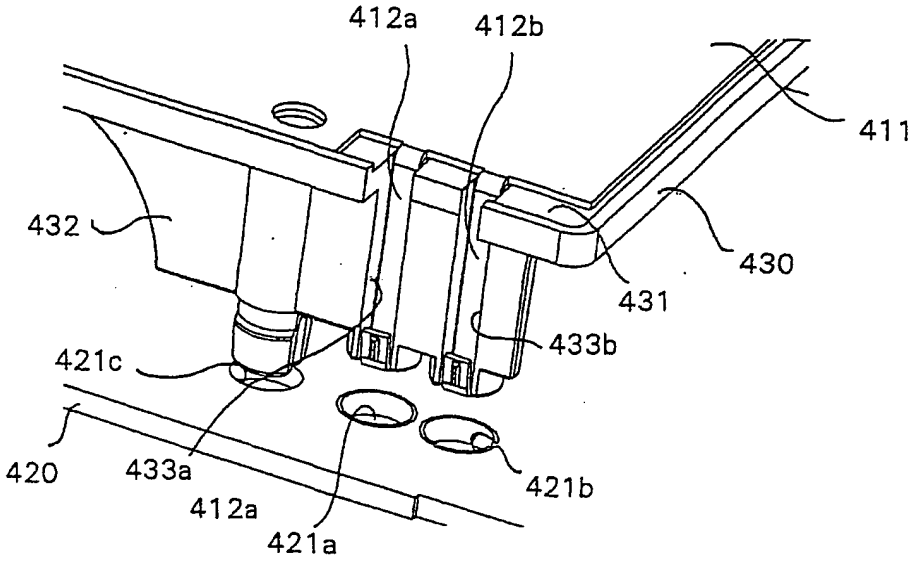


Fig. 4a

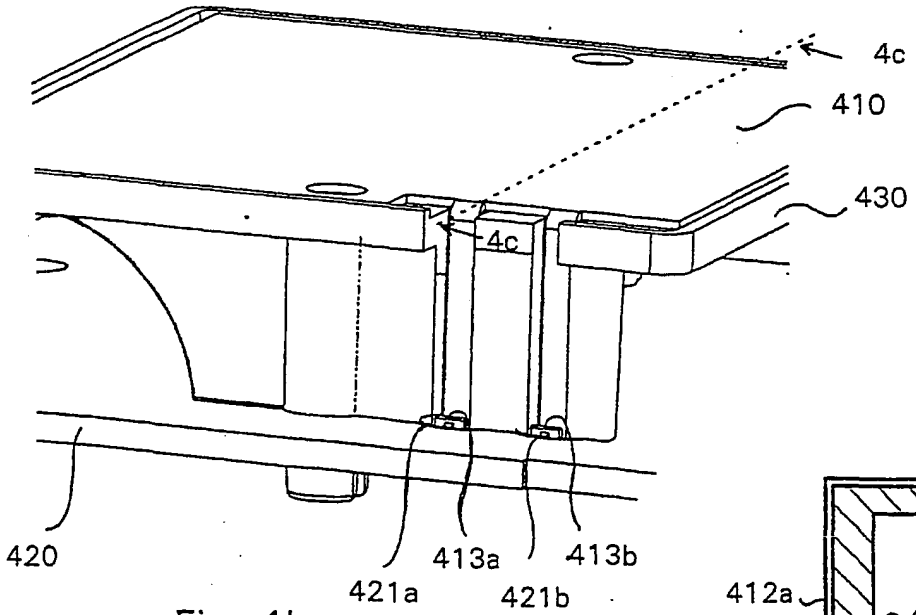


Fig. 4b

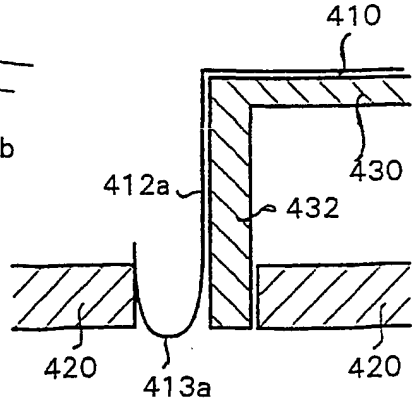


Fig. 4c

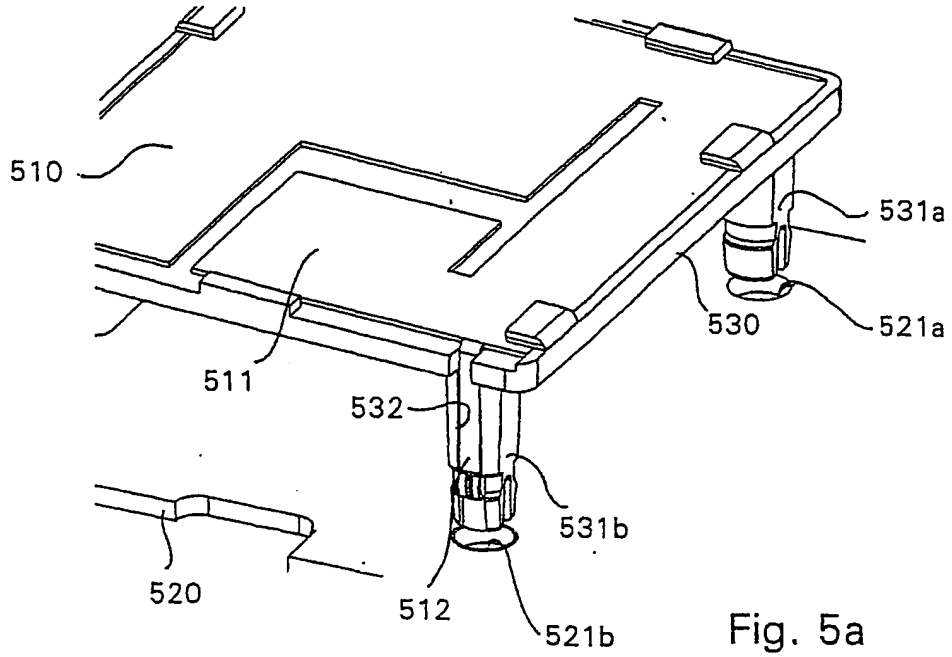


Fig. 5a

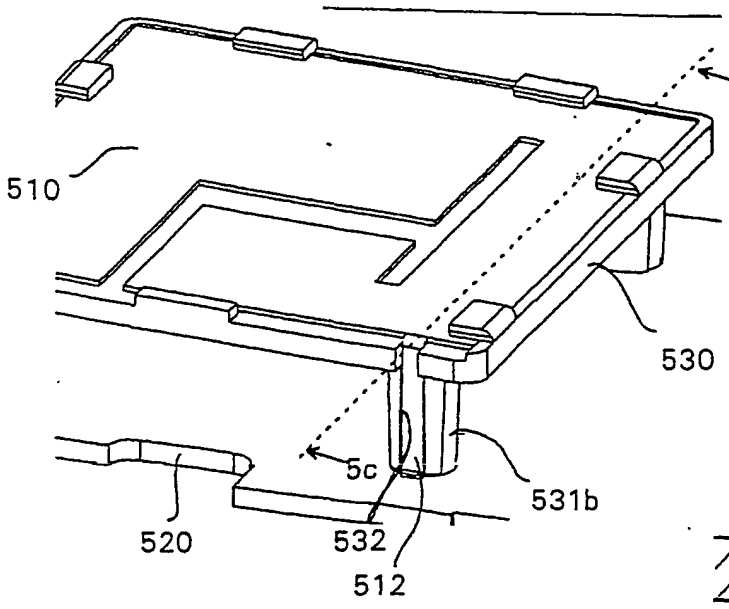


Fig. 5b

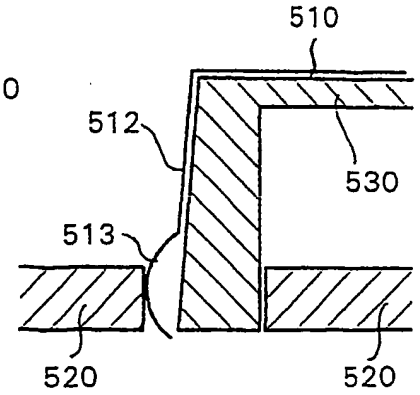


Fig. 5c

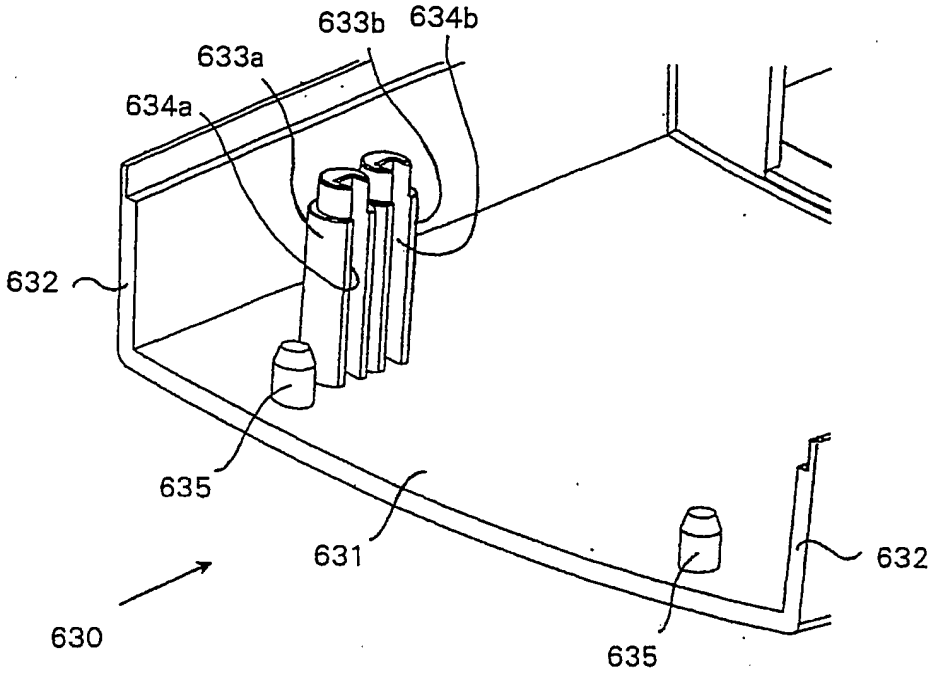

633b
634b
633a
634a
632
635
631
632
630
635

Fig. 6a

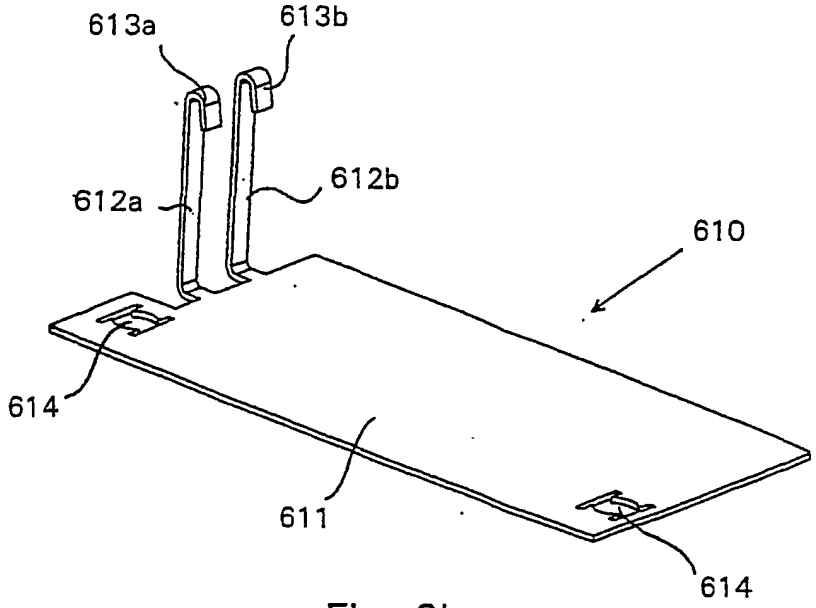
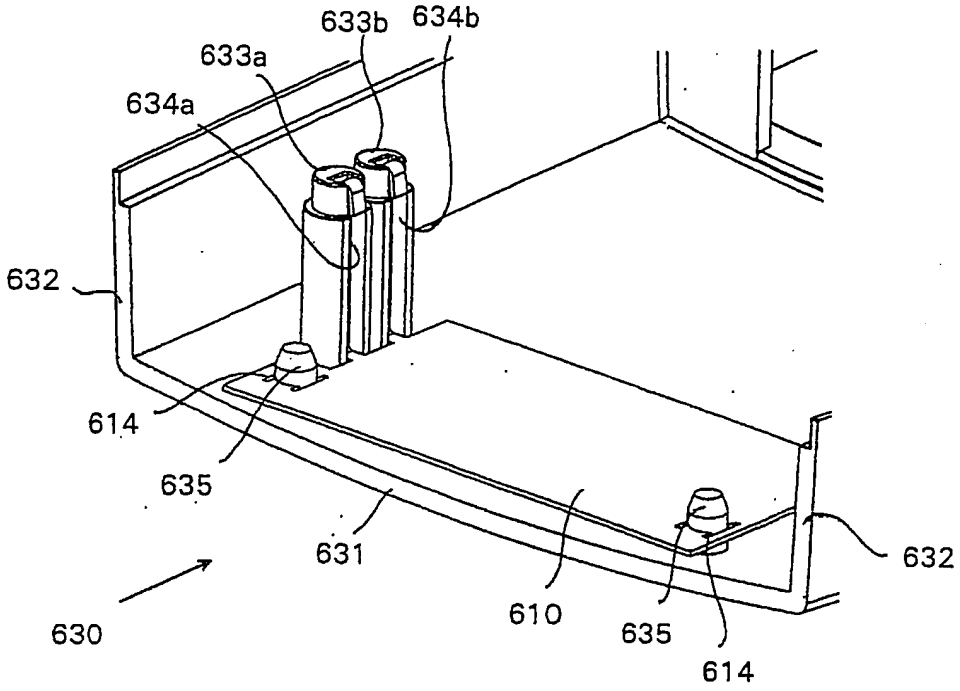

613a
613b
612b
612a
610
614
611
614

Fig. 6b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634b
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634a
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635
614

Fig. 6c

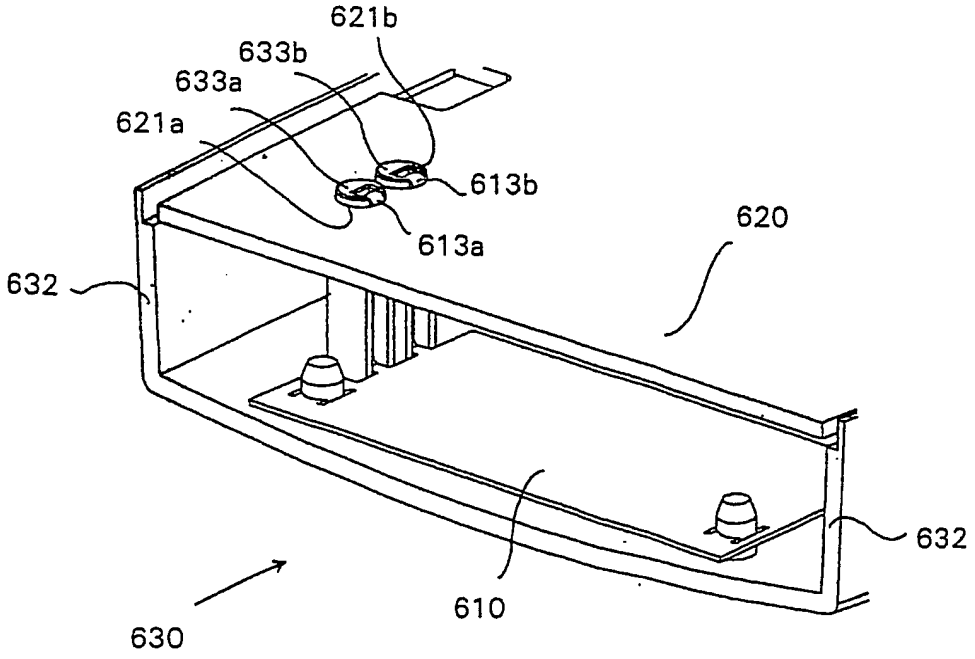
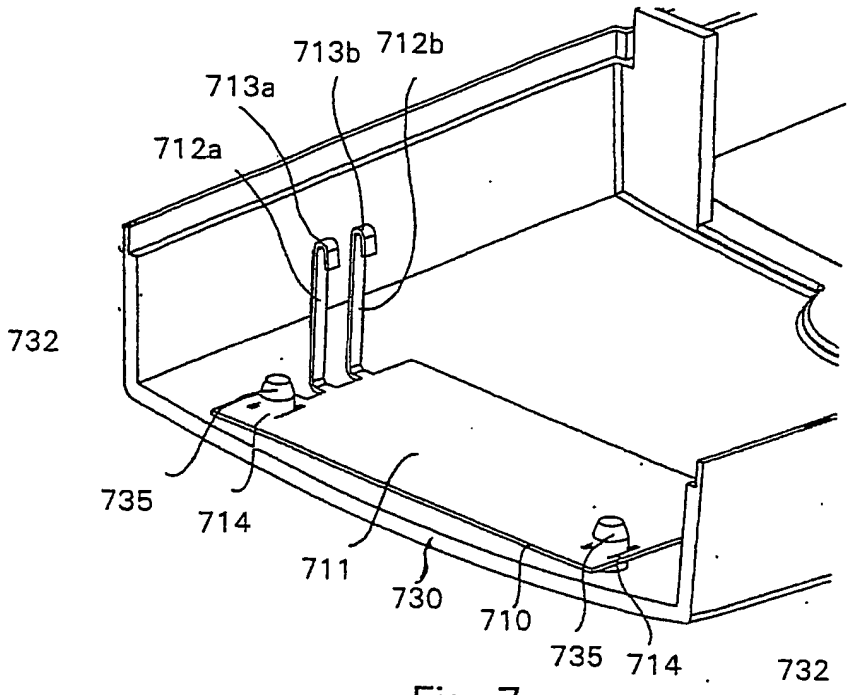

621b
633b
633a
621a
613b
613a
620
632
632
610
630

Fig. 6d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712a
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732

Fig. 7a

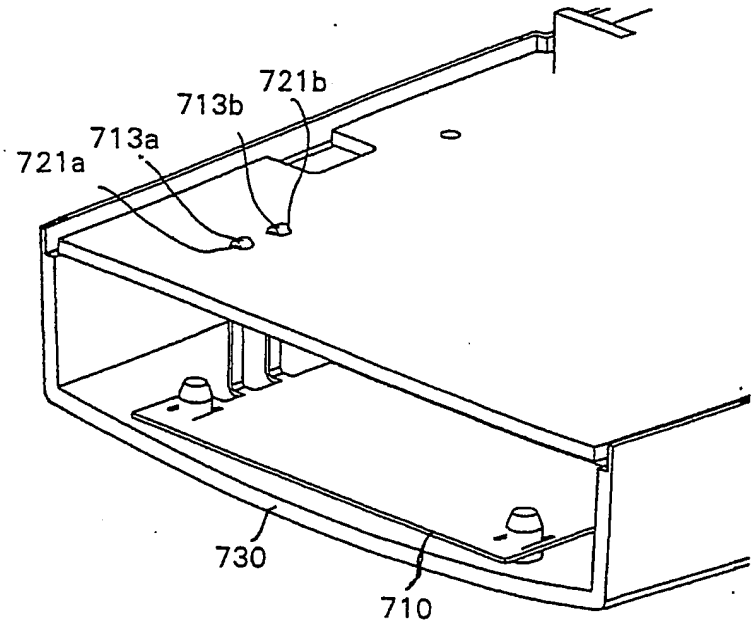

721b
713b
713a
721a
730
710

Fig. 7b

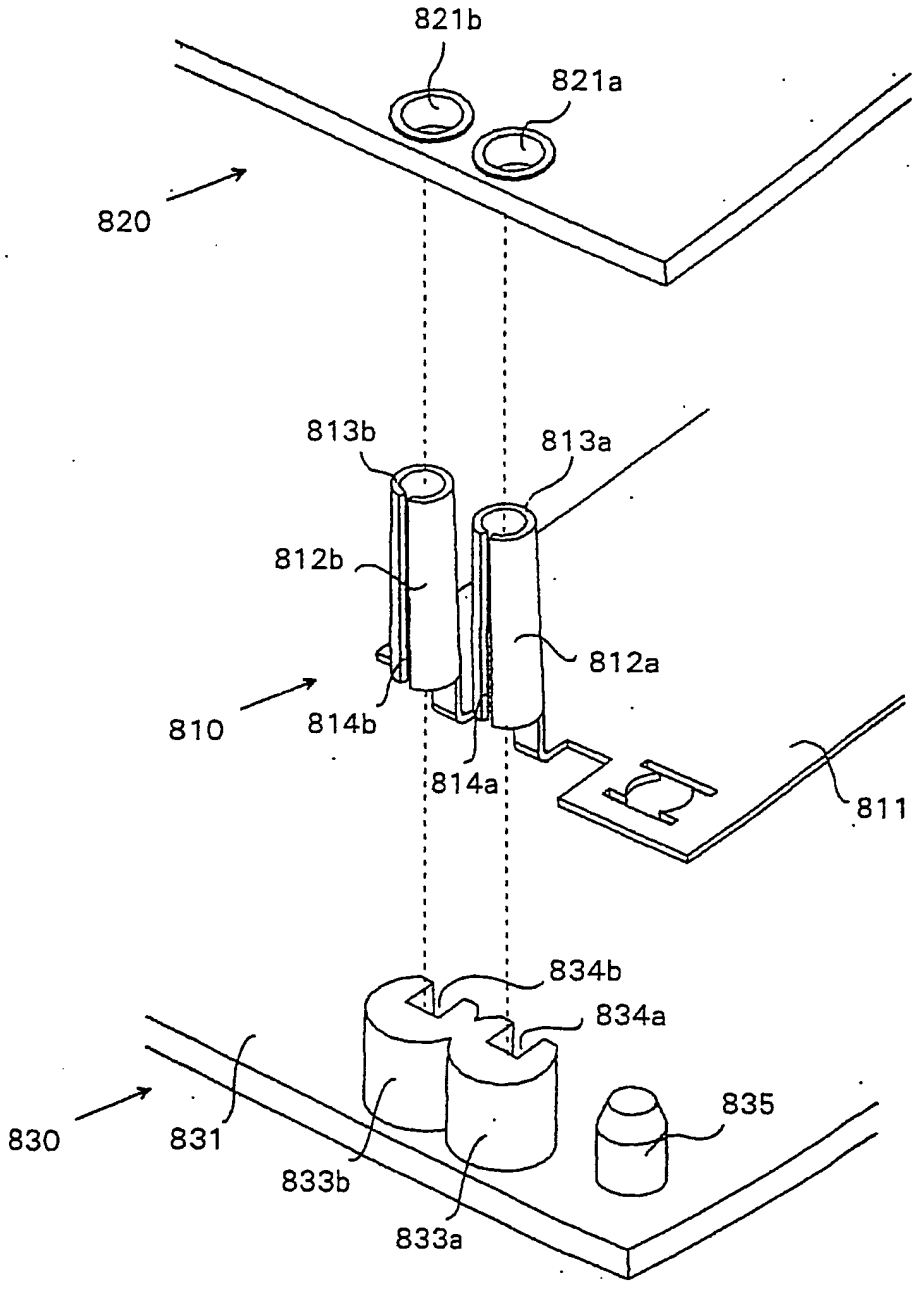
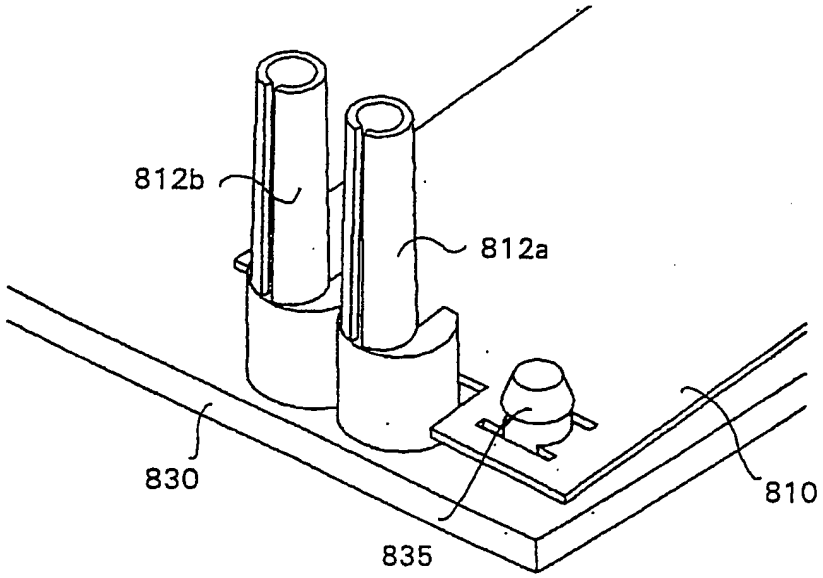

821b
821a
820
813b
813a
812b
812a
810
814b
814a
811
834b
834a
835
830
831
833b
833a

Fig. 8a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835

Fig. 8b

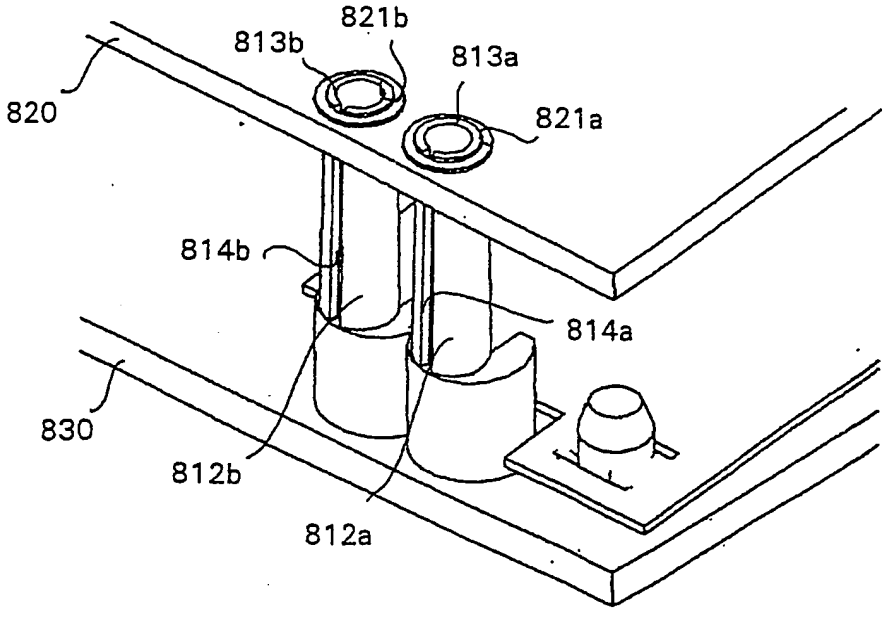
821b
813b
813a
820
821a
814b
814a
830
812b
812a

Fig. 8c

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 01/02070

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H01Q 1/22, H01R 12/16
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: H01R, H01Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5014071 A (JEFFREY S. KING), 7 May 1991 (07.05.91), column 1, line 11 - line 16; column 2, line 60 - column 3, line 33, figure 1	1-4,7-10, 13-22
X	DE 2805618 A1 (AMP INC.), 16 August 1979 (16.08.79), page 6, line 10 - line 24, figures 3,6	1-6
X	GB 2346263 A (MOTOROLA INC), 2 August 2000 (02.08.00), page 1, line 20 - page 2, line 5; page 6, line 7 - line 34, figures 1,3	1,11-12
A	DE 19856667 A1 (ROBERT BOSCH GMBH), 29 June 2000 (29.06.00), figures 1-2, abstract	1-4,7-17, 19-22

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
5 December 2001	14-01-2002
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Kerstin Waczinska/MN Telephone No. +46 8 782 25 00

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 01/02070

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5907817 A (GREGORY S. MENDOLIA), 25 May 1999 (25.05.99), figures 3,6-7,10-11, abstract -- --------	1,13,18,22

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/SE 01/02070

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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GB 2346263 A	02/08/00	CN 1254203 A	24/05/00
		GB 9926073 D	00/00/00
		US 6133885 A	17/10/00
DE 19856667 A1	29/06/00	NONE	
US 5907817 A	25/05/99	US 6181950 B	30/01/01